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WIRING TEST PROGRAM INSULATION MATERIAL RELATED PROPERTIES

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325
p 7

TABLE OF CONTENTS

INTRODUCTION

- Electrical wires are considered as EEE-parts and are covered within the ESA SCC specification series (ESA SCC 3901/XXX).

- Specifications define the principal properties of the wires including insulation/lay-up, electrical properties etc.
  Some additional space related materials requirements also included such as outgassing and silver plating thickness.

- If a project has additional materials requirements over and above those covered by the relevant SCC specification then additional testing is required.

  This is especially the case for manned spacecraft.

Additional requirements for manned spacecraft:

- The following additional properties, specific to manned spacecraft (i.e. Columbus and Hermes) require evaluation of:

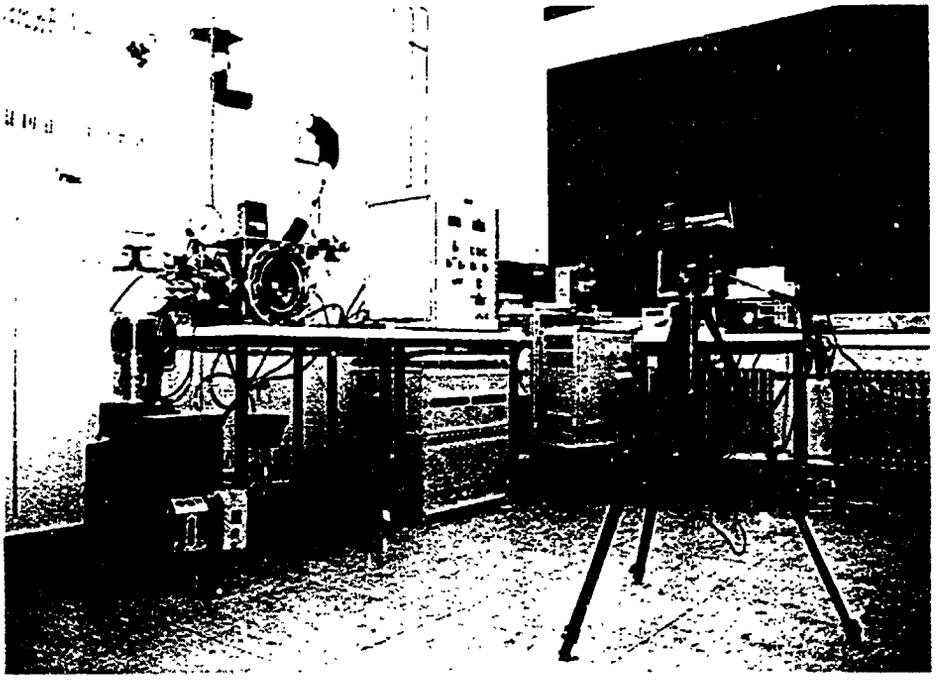
1.	Flammability	Test Method ESA-PSS-01-721 Issue 2
2.	Offgassing	Test Method ESA-PSS-01-729 Issue 2
3.	Arc-tracking	Test Method under evaluation by Dasa-RI in conjunction with Technical University, Darmstadt (see also separate presentation)
4.	Thermal Decomposition	Test Method defined based on that originating from CERTSM, France
5.	Microbial Surface Growth	Test Method defined based on that originating from SINTEF/SI, Norway

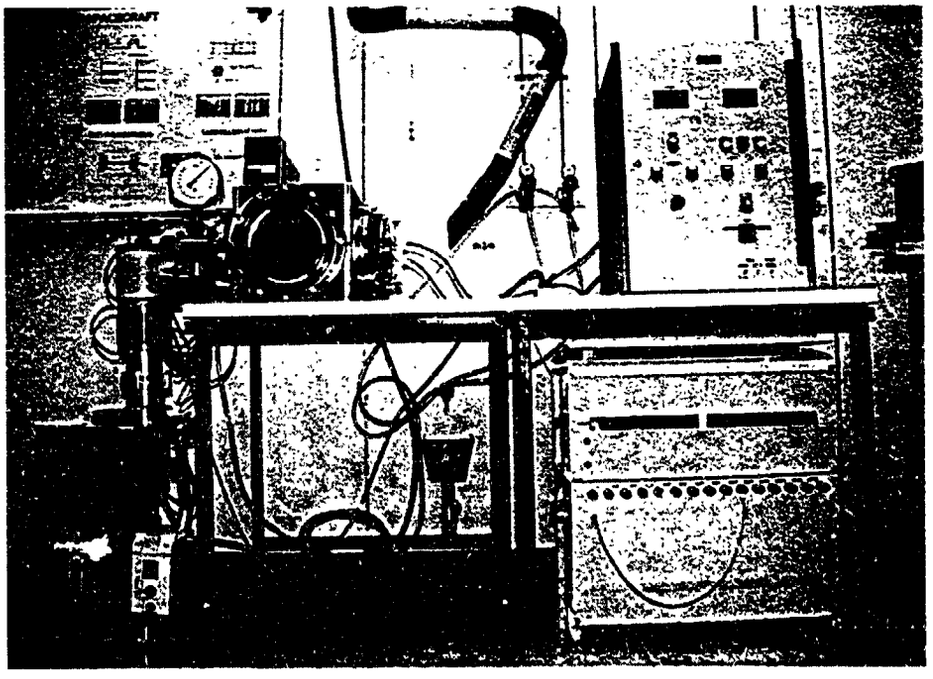
Note: 4. and 5. are Test Methods derived in the frame of the Columbus Project (Critical Technologies Program)

- In addition, the effects of ageing on certain of these properties require investigation.

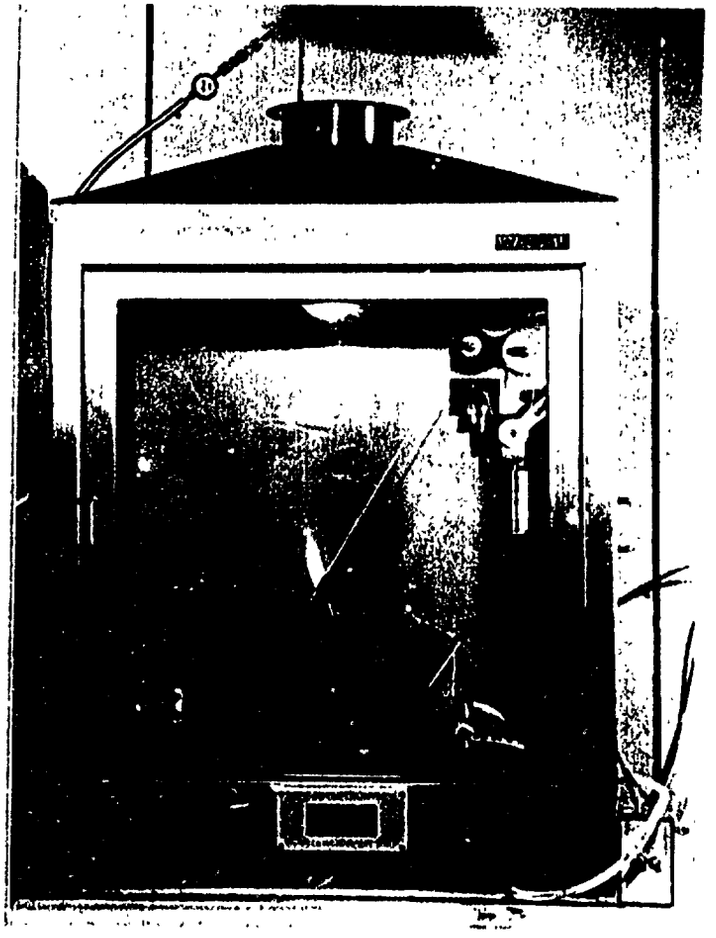
OVERVIEW OF ACTIVITIES AT DASA-RI (since last Workshop)

- o Establishment of test facilities at Dasa-RI
  - Arc-tracking test of wires
  - Flammability test of wires
- o Arc-tracking: Technical University Darmstadt / Dasa-RI activities
  - Extension of database (see also presentation of THD)
  - Design of test equipment to assess effects of microgravity
- o Performance of wiring testing at Dasa-RI
- o Performance of studies, e.g. ageing of wires, different angles of wire inclination of flam-of-wires test
- o Performance of wiring testing in the frame of Columbus Critical Technologies Program (CTP)
- o Activities concerning standardization of test methods (British Standard, ISO)





Arctracking Test of Wire at Dasa-RI



Electrical Wire Insulation Flammability Test at Dasa-RI

ARC-TRACKING: THD / DASA-RI ACTIVITIES UNDER ESA/ESTEC CONTRACTS

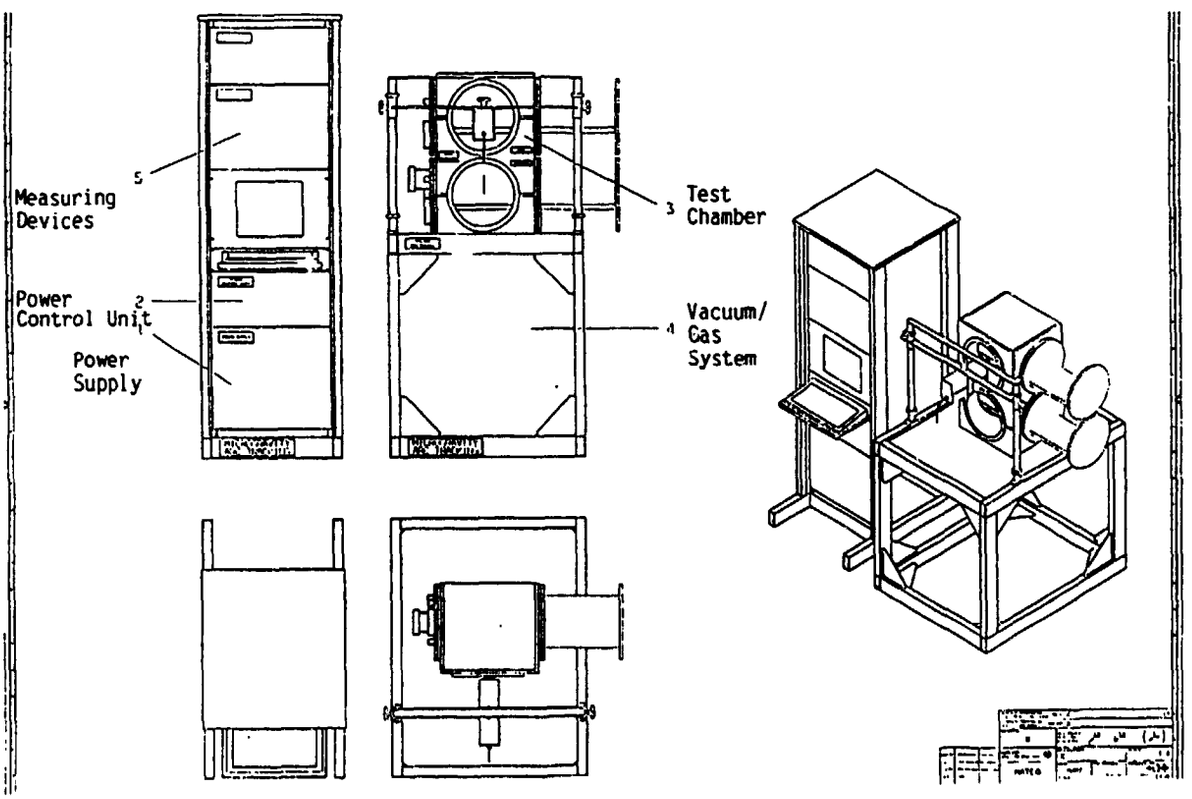
Arc-Tracking Test Equipment / Test Method

- Two test equipments are existing (at THD and at Dasa-RI)
- Test method developed by THD (already presented)
  Work has led to a new approach to assessing degree of susceptibility of wires to arcing failure
- Lot of testing has been performed (see separate presentation by THD)

Mircrogravity Test

- Test equipment is being designed, procurement and manufacturing started
- Parabolic flight is scheduled during 1996

ARC-TRACKING: MICROGRAVITY TEST EQUIPMENT



WIRING TESTING AT DASA-RI

First Test Results [AWG 20]

Wire Specification	Insulation	Performance of Tests	
SCC-3901-001	PI/PI/PI	Upward propagation test	) Prior and after ageing
SCC-3901-007	PI/PI/PTFE	Flam of wire test	) of 60 days in air
SCC-3901-009	PTFE/PI/PI	Arc-tracking test	) at 150° C
MIL-W-22759	ETFE		

- o All wires (new and aged) passed the upward propagation and flam of wire test according to ESA-PSS-01-721, Issue 2
- o Arc-tracking test results using Dasa-RI inhouse test procedure PSP 0121 009 showed clear differences between different wire types.
  Accept/Reject Criteria have to be reconsidered.

WIRING TESTING IN THE FRAME OF COLUMBUS CRITICAL TECHNOLOGIES PROGRAM (CTP)

- o 10 different wire/cable types have been subjected to different tests, selected from the so called "Columbus EEE Preferred Parts List"

Sample No.	Sample Name	Chemical Nature
1901	1871-1-20	PI (2 tapes)/ PI coating
1903	FA 3901-1-120	PI (2 tapes)/ PI coating
1904	FA 3901-2-120	PI (1 tape)/ PI coating
1908	SPA-10-24-9	PI/PI/PTFE
1909	SPB-10-20-6	PTFE/PI/PI/PTFE
1910	SPC 10-24-N	PTFE/PI PI
1911	MTV 1 20-A	PTFE (ext) PI coating
1912	Coaxcal Cable 50 CIS	PTFE/Ag/Al
1913	Coax Cable R59	PI/ext. FEP
1914	1872-1-20	Pi (1 tape)/ PI coating

- o Cables/Wires passed the following tests:
  - Upward propagation test)
  - Flammability of wire) performed
  - Odor) according to
  - Offgassing) ESA-PSS-Specs.
  - Outgassing)

WIRING TESTING IN THE FRAME OF COLUMBUS CRITICAL TECHNOLOGIES PROGRAM (CTP)

o Additional tests have been performed

- Microbial Growth (Fungi) (short duration test up to 4 weeks)

Material No.	Chem. Nature	Class
1901	PI, PI Coating	3
1903	PI, PI Coating	3
1904	PI, PI Coating	4
1909	PTFE/PI/PI/PTFE	4
1910	PTFE/PI/PI	0
1911	PTFE/PI Coating	3-4
1912	PTFE/Ag/Pi	0
1913	PI/FEP	4
1914	PI/PI Coating	3

Rating: (Growth of fungi)

0 + 1	No constraints on materials (no growth)
2 + 3	Materials to be used in dry accessible areas (cleaning)
4 + 5	Materials should not be used in manned closed space habitate (heavy growth)

WIRING TESTING IN THE FRAME OF COLUMBUS CRITICAL TECHNOLOGIES PROGRAM (CTP)

o Additional tests have been performed

- Thermal Decomposition (at 200° C or max. operating temperature and at 500° C; Atmosphere 24,5 Vol % O_2)

Material Group or Form	Mat. Ident. No.	Tradename	Toxicity Class at 200° C	Toxicity Class at 500° C
WIRES	1901	Wire Type: 1871	T0	T2
	1903	Wire Type: 3901/1	T0	T2
	1904	Wire Type: 3901/2	T0	T2
OR	1908	Wire Type: SPA 2110	T0	T3
	1909	Wire Type: SPB 2110	T0	T3
	1910	Wire Type: SPC 2110	T0	T2
CABLES	1911	Wire Type: MTV	T0	T3
	1912	Coax Cable 50 CIS	T0	T2
	1913	Coax Cable R 59	T0	T3
	1914	Wire Type: 1872	T0	T2

Critical Quantity of Materials - QCM (g/m^3)	TOXICITY CLASS
< 0,10	T 5
0,10 - 1	T 4
1 - 10	T 3
10 - 100	T 2
100 - 1000	T 1
> 1000	T 0

Arc-Tracking and Flam of Wire Test Methods

- Methods will be proposed to

  ISO Technical Committee TC 20, Aircraft and Space Vehicles, SC 14, Working Group 1

- Flam of wire test method acc. to ESA-PSS-01-721
  - is under evaluation by British Standard for incorporation into their aircraft wire spec.,
  - now being incorporated into ESA SCC 3901 series of spec's.

Space Systems -
Arc Tracking Test,
Cables and Wires

Space Systems -
Wire Flamm Test,
Electrical Wire Insulation

FUTURE ACTIVITIES

- Further investigations (on going) to flam of wire test, e.g. angle of wire inclination
- Extension of database on arc-tracking tests, e.g. test of fungi contaminated wires, variation of test parameters (current, voltage, etc.)
- Reconsideration of Accept/Reject Criteria for arc-tracking test method
- Standardization of test methods
- Request from Russia to perform arc-tracking tests with 4 polyimide insulation wires delivered by RSC-Energia, Moscow (comparison of test methods / test results)
- Performance of Parabolic Flight (1996): Influence of microgravity on arc-tracking